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This book is affectionately dedicated to my patients whose courage is my guiding light.

To my parents whose interest in this, as in all my ventures was never less than my own.

To my dear husband Rick, whom I met in college, and who has made every single moment of my life better ever since.

The final word of gratitude is to my incredible three sons for teaching me that indeed *only from the heart can you touch the sky*.

Maie A. St. John

This book is dedicated to my wife Kara, and our sons Sam and Nate.

I would like to thank my mentors, teachers, colleagues, and friends whose support and company have made travel along this career path possible and a joy.

Finally, I hope readers gain something from this book that helps them care skillfully and compassionately for their patients.

Benjamin L. Judson

Contents

Foreword and Acknowledgments

As the knowledge of medicine has grown exponentially, it is necessary to have books each encompassing one subspecialty. I had the vision of creating a book for each subspecialty building from the formula and on the success of Essential Otolaryngology-Head and Neck Surgery, the inceptive book, which is in its 12th Edition, 49th year, and has been translated into several languages. It was cited as one of the most read texts in the field worldwide. Working with President Nadya S. Gotsiridze-Columbus, CEO of Nova Science Publishers, Inc., we developed K. J. Lee Essential Medicine Series, to host the subspecialty books. After a national search, we were fortunate to have Dr. Ben Judson and Dr. Maie St. John to be Editors of this book and Dr. Josephine Nguyen to be Assistant Editor to compile the ever important Practice Guidelines. We commend the scholarly contents of the chapter contributing authors. It is with great pleasure and honor for me to say they all worked very hard and have done a superb job. I thank them all and kudos to them.

Like the inceptive book, I have no doubt this book will find its way to libraries, to the reference sections of emergency rooms, urgent care centers, as well as the dorm rooms, apartments, and homes of medical students, residents, fellows, young attendings, physician assistants, nurse practitioners and others.

This book is not only a great text and reference for medical professionals, but it can also be of value for people outside the medical field to understand key concepts in order to better communicate with providers.

K. J. Lee, MD, FACS, Editor-in-Chief
KJ Lee Essential Medicine Series

Preface

This textbook presents a succinct yet comprehensive overview of the current essential topics in the multidisciplinary care of head and neck cancer patients. With each chapter written by experts in the many fields that comprise head and neck oncology and surgery, this compendium provides a unique, multidisciplinary perspective on the diagnosis and management of these patients. Information is presented in outline format to optimize the learning experience with multiple-choice questions to consolidate learning and practice guidelines to strengthen one's grasp of the topics while presenting the opportunity for efficient reference. Finally, this textbook's outline format, clear and concise language, and rich set of practice guidelines make it a trusted resource for nonmedical professionals hoping to learn more about head and neck cancer patients and their treatments.

Chapter 1

Oral Cavity, Pharynx, and Larynx Anatomy, Physiology, and Other Basics

Sagar Kansara, MD
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Oral Cavity

Anatomy (see Figure 1) – anatomic space from vermilion border to junction of hard/soft palate and circumvallate papillae

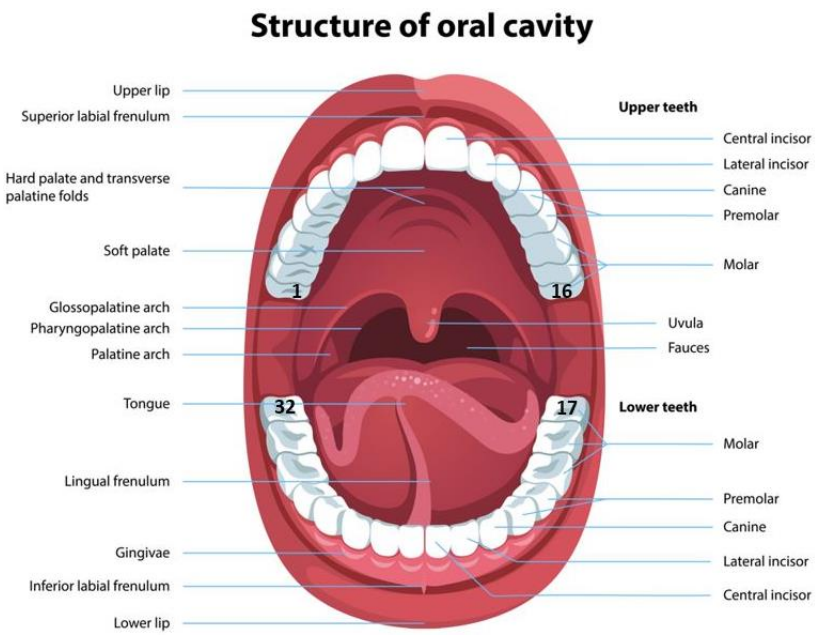

Figure 1. Oral cavity anatomy.

1. Subsites
    a. Vestibule
        i. Wet lip

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        ii. Labial and buccal gingiva and dentition
        iii. Buccal mucosa
    b. Oral cavity proper
        i. Oral tongue-ventral, dorsal, lateral border
        ii. Alveolar ridge
        iii. Mesial dentition and gingiva
        iv. Hard palate
        v. Floor of mouth
        vi. Retromolar trigone
2. Contents
    a. Minor salivary glands – hundreds scattered throughout mucosa, palate, oral tongue, base of tongue
    b. Salivary ducts
        i. Parotid duct (Stensen)-lateral to second molars
        ii. Wharton's duct-midline floor of mouth, near the lingual frenulum
    c. Dentition – 32 adult teeth, numbered from superior right to superior left (1-16), inferior left to inferior right (17-32)
    d. Oral tongue
        i. Papillae – house taste buds, covers surface of anterior 2/3 of tongue
    e. Filiform
    f. Fungiform
    g. Foliate
    h. Circumvallate – V shape at the junction of anterior 2/3 and posterior 1/3, posterior to sulcus terminalis
        i. Lingual frenulum – mucosal fold attaching tongue to floor of mouth and gingiva.
        ii. Foramen cecum – see embryology
        iii. Lingual tonsil, vallecula – see oropharynx
3. Lymphatic drainage
    a. Oral cavity most often drains to level Ia, Ib, IIa, III. Midline structures such as anterior floor of mouth and tongue tip/posterior tongue often drain bilaterally.
4. Musculature
    a. Extrinsic tongue muscles (CN XII)
        i. Genioglossus
        ii. Hyoglossus
        iii. Styloglossus
        iv. Palatoglossus
    b. Intrinsic tongue muscles (CN XII)
        i. Longitudinal
        ii. Vertical
        iii. Transverse
    c. Floor of mouth musculature
        i. Mylohyoid (CN V-nerve to mylohyoid)
        ii. Geniohyoid (cervical plexus)

iii. Anterior belly of digastric (CN V)

5. Arterial Supply
    a. Lingual artery branches
        i. Deep lingual
        ii. Dorsal lingual
        iii. Sublingual
        iv. Suprahyoid
    b. Facial artery branches
        i. Tonsillar
        ii. Labial
        iii. Ascending palatine
    c. Internal maxillary artery branches
        i. Descending palatine artery (via greater and accessory palatine foramen)
6. Innervation
    a. Anterior 2/3 tongue – CN V3 mediates pain, touch, temperature. Taste via chorda tympani. Lingual nerve -> chorda tympani -> geniculate ganglion -> nervus intermedius -> nucleus solitarius
    b. Greater palatine foramen-transmits descending palatine branch of V2 for sensory afferents, medial to upper second molar
7. Embryologic origin
    a. Fourth week of gestation, 1st-4th pharyngeal arches contribute
    b. Tuberculum impar (first arch) joins with lateral lingual swellings to form anterior 2/3 tongue
    c. Hypobranchial eminence develops concurrently to form posterior 1/3
    d. Foramen cecum: invagination of the sulcus terminalis, origin of embryologic thyroid from which it descends into the neck.

Oropharynx

1. Anatomy – hard/soft palate junction to vallecula
2. Subsites
    a. Base of tongue (posterior 1/3 of tongue)/lingual tonsil
    b. Palatine Tonsil, lateral pharyngeal wall
    c. Posterior pharyngeal wall
    d. Uvula/soft palate
    e. Pharyngoepiglottic and glossoepiglottic folds
    f. Vallecula
3. Lymphatic drainage
    a. Level IIa, IIb, III, IV, rarely level I
    b. Midline structures such as base of tongue drain bilaterally

4. Musculature (via CN X, pharyngeal plexus)
    a. Palatoglossus (CN X)
    b. Palatopharyngeus (CN X)

c. Musculus uvulae (CN X)
d. Levator palatini (CN X)
e. Tensor veli palatini (CN V3)
f. Stylopharyngeus (CN IX)
g. Superior constrictor (CN IX/X- pharyngeal plexus)

5. Arterial Supply
   a. Lingual artery branches (see oral cavity)
   b. Facial artery branches (see oral cavity)
   c. Ascending pharyngeal (via tonsillar branch)
   d. Maxillary (via descending palatine/tonsillar branch)
6. Innervation
   a. Posterior 1/3 tongue- visceral afferents (touch and gag) as well as sensation via CN IX to nucleus solitarius. Taste (base of tongue and valleculae papillae) also nucleus solitarius via CN IX.
   b. Palate: sensory afferents via nasopalatine and greater palatine nerves (CN V)
7. Embryologic origin
   a. Tonsil-second pharyngeal pouch. Tonsillar pillars arise from the second and third arches. (see Figure 2)

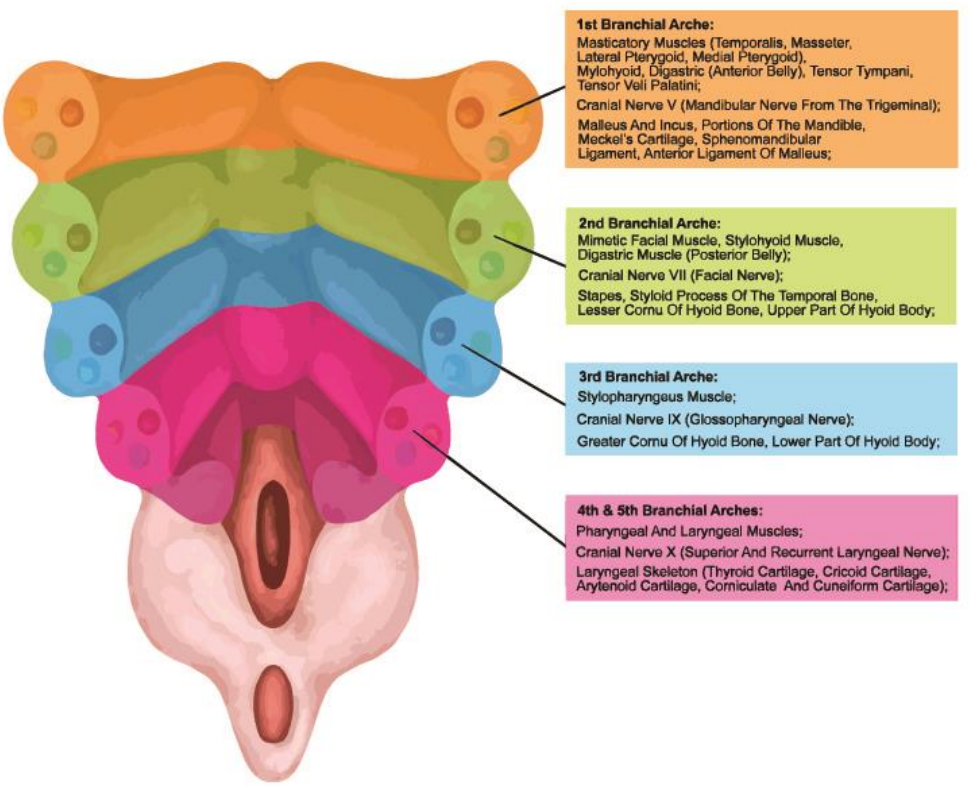

Figure 2. Branchial arch derivatives.

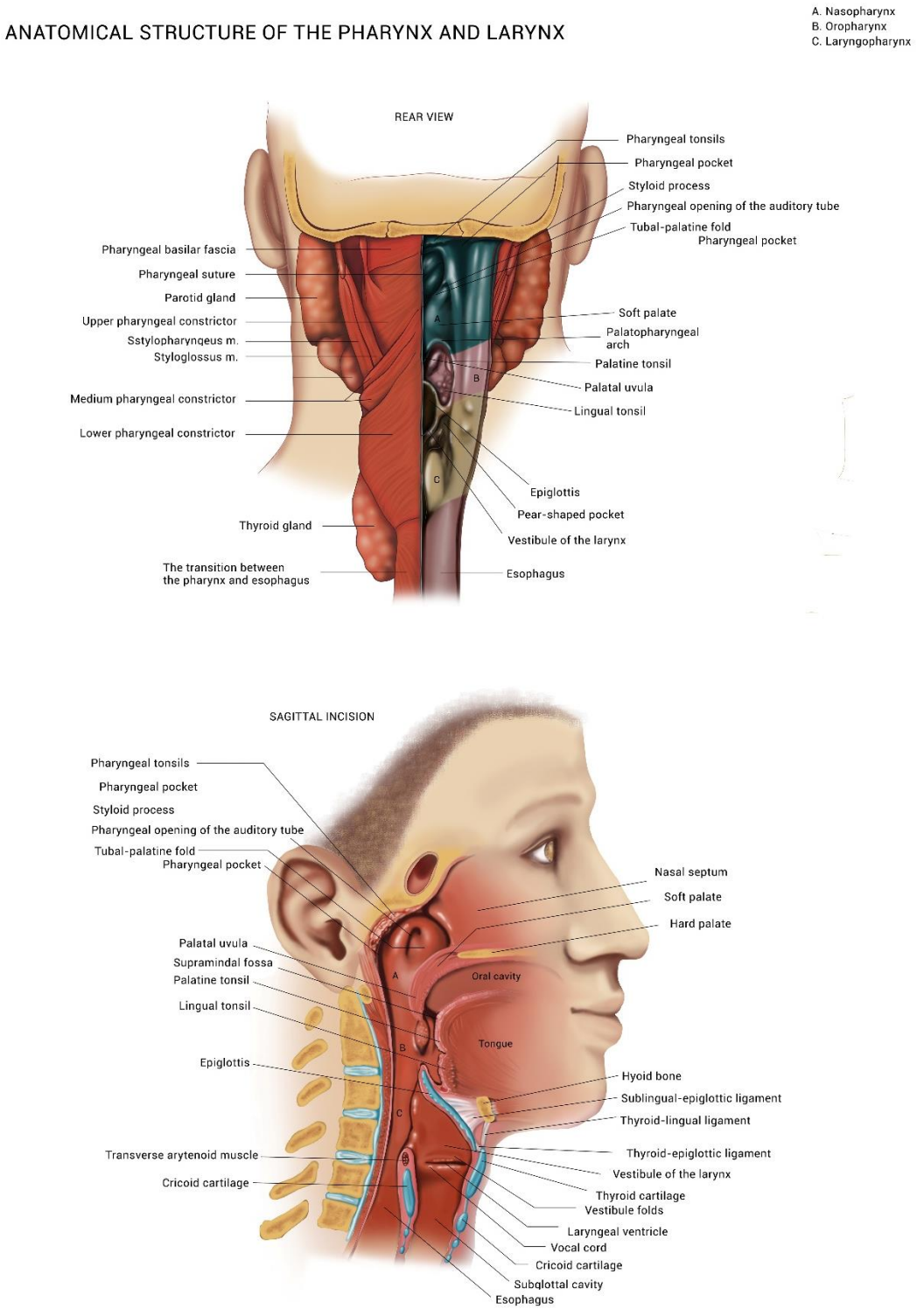

Figure 3. Larynx and pharynx anatomy.

Larynx and Hypopharynx

1. Anatomy (see Figure 3)-Lingual surface of epiglottis to esophageal inlet and cricoid
    a. Supraglottis
        i. Epiglottis (supra and infra-hyoid)
            - Quadrangular membrane – supporting fibroelastic membrane, extends from epiglottis to arytenoid/corniculate
            - Pre epiglottic space: bounded by hyoepiglottic ligament superiorly, thyrohyoid membrane anteriorly, epiglottis and thyroepiglottic ligament posteriorly
        ii. Aryepiglottic folds
        iii. Arytenoids
        iv. False vocal folds
    b. Glottis
        i. True vocal folds
            - Conus elasticus – supporting fibroelastic membrane, extends from cricoid to merge with vocal ligament
            - Reinke's space – superficial lamina propria of true vocal fold
            - Paraglottic space: bounded by thyroid cartilage laterally, quadrangular membrane superomedially, ventricle medially, conus elasticus inferomedially, posteriorly by piriform sinus
        ii. Anterior commissure
    c. Subglottis/trachea
        i. Glottis to inferior border of cricoid
    d. Hypopharynx
        i. Post cricoid space
        ii. Piriform sinus
2. Lymphatic drainage
    a. Level IIa, IIb, III, IV, VI, VII
    b. Supraglottis, post cricoid space, anterior commissure – bilateral nodal drainage
3. Musculature
    a. Laryngeal musculature
        i. Intrinsic
            - Transverse arytenoid
            - Lateral cricoarytenoid
            - Posterior cricoarytenoid (only abductor of vocal cord)
            - Vocalis/Thyroarytenoid
                – Broyle's tendon – insertion of vocalis tendon to thyroid cartilage
            - Cricothyroid-vocal fold tension-pitch.
        ii. Extrinsic
            - Suprahyoid musculature
            - Infrahyoid musculature
            - Stylopharyngeus
            - Arterial Supply

- Superior laryngeal artery (via superior thyroid artery-External carotid) – supraglottis
- Inferior laryngeal artery (via inferior thyroid artery-thyrocervical trunk) – Glottis and subglottis

4. Innervation
    a. Superior laryngeal nerve (CN X) – internal – sensation of supraglottis, external-motor to cricothyroid
    b. Recurrent laryngeal nerve (CN X) – all intrinsic muscles of larynx except for cricothyroid (via external branch of SLN)
        i. Right – loops around subclavian
        ii. Left – loops around arch of aorta
        iii. Non recurrent nerve more common on the right – can result from aberrant subclavian artery, resulting in dysphagia lusoria. Rarely can occur on the left – associated with situs inversus.
    c. CN X/pharyngeal plexus – sensation to pharyngeal, esophageal inlet mucosa
5. Embryologic origin (see Figure 2)
    a. Supraglottis – third and fourth arch
        i. Glottis and subglottis – sixth arch

Physiology

a. Swallow
    i. Oral phase
        - Mastication - Muscles of mastication (CN V3)
            - Pterygoids (medial and lateral)-lateral pterygoid is the only muscle to protrude and open the jaw
            - Masseter
            - Temporalis
        - Salivation (visceral efferent)
            - Parotid gland
                - Inferior salivatory nucleus -> Glossopharyngeal -> Jacobson's nerve -> Lesser petrosal nerve (pre ganglionic parasympathetic) -> Otic ganglion -> Auriculotemporal nerve to parotid
            - Submandibular and sublingual gland
                - Superior salivatory nucleus -> nervus intermedius -> facial nerve -> chorda tympani (pre ganglionic parasympathetic) -> submandibular ganglion -> gland
        - Control and preparation of bolus via buccinator, palate, tongue, lips, dentition, orbicularis
    ii. Pharyngeal phase-bolus transit from oropharynx through upper esophageal sphincter into esophagus

a. Palate elevation (levator/tensor muscles) and posterior movement to contact posterior pharyngeal wall (Passavant ridge), thus preventing velopharyngeal insufficiency.
b. Glottic closure, true and false fold as well as arytenoid contraction
c. Hyoid and larynx move superiorly and anteriorly
d. Bolus propulsion via tongue base and constrictor contraction
e. Relaxation of upper esophageal sphincter, cricopharyngeus

iii. Esophageal phase
a. Primary peristalsis and relaxation of lower esophageal sphincter

Chapter 2

Temporal Bone and Skull Anatomy, Physiology, and Other Basics

Sujana S. Chandrasekhar, MD
and Hosakere K. Chandrasekhar, MD

Temporal Bone Pneumatization, Bony (Osseous) Anatomy, and Muscular Attachments

1. The paired temporal bones are located at the lateral skull base in a pyramidal shape with the base laterally and apex medially and are pneumatized (aerated).
    a. The reasons for temporal bone pneumatization are postulated to include:
        i. pressure buffer
        ii. gas reserve
        iii. shock absorption spaces
    b. Spaces that are pneumatized are, from laterally to medially:
        i. Mastoid – the largest air space in the mastoid is called the antrum
        ii. Aditus ad antrum – connection between mastoid and tympanic cavities
        iii. Tympanic cavity (including epitympanum, hypotympanum, protympanum)
        iv. Petrous apex – can be aerated or filled with marrow bone
    c. *Practice Guideline: Poor pneumatization of the temporal bone correlates with increased incidence and poor prognosis of: atelectasis, otitis media, cholesteatoma, and otic capsule injury in temporal bone fracture.*
2. The temporal bone is comprised of six different bones:
    a. Squamous
        i. Is the largest part of the temporal bone, flat and plate-like, located anterosuperiorly
        ii. The external surface of the squamous bone is convex in shape and this temporal fossa and the lower part of the squamosa are the site of origin of the temporalis muscle
        iii. It articulates superiorly with the parietal bone and anteroinferiorly with the greater wing of the sphenoid bone

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b. Petrous
    i. Located posteriorly and medially
    ii. Is pyramid-shaped
    iii. Contains the inner ear and transmits the internal auditory canal and carotid artery
c. Mastoid
    i. Located posteriorly and laterally
    ii. Lateral surface gives attachment to splenius capitis and longissimus capitis, overlain by sternocleidomastoid.
    iii. From the medial surface it gives attachment to the posterior belly of the digastric muscle
    iv. Its inferior portion is the mastoid process, which is absent or rudimentary at birth and only forms postnatally as the sternocleidomastoid muscle develops and pulls on the bone.
        - *Practice Guideline: Because the extratemporal facial nerve is not protected by the mastoid bone at birth or in early childhood, it is susceptible to blunt trauma such as forceps delivery or a minor fall and is susceptible to laceration injury from a postauricular incision that extends inferiorly.*
d. Tympanic
    i. Lies inferiorly to the squamous, and anteriorly to the petromastoid
    ii. Reversed C-shaped
        - Posterior surface goes into the formation of the external auditory meatus
        - Anterior surface forms the posterior wall of the non-articular mandibular fossa
e. Zygomatic Process
    i. Arises from the lower part of the squamous bone
    ii. Projects anteriorly, articulating with the temporal process of the zygomatic bone, to form the zygomatic arch
    iii. Posteriorly, it has a downward projection called the articular tubercle, which is the anterior boundary of the mandibular fossa, the articular part of the temporomandibular joint (TMJ)
    iv. The masseter muscle attaches to the inferior and medial surfaces of the zygomatic process
f. Styloid Process
    i. Located immediately inferior to the opening of the auditory meatus
    ii. Acts as an attachment point for muscles and ligaments, such as the stylopharyngeus muscle and the stylomandibular ligament of the TMJ

3. The bony external auditory canal is nearly 2 cm long and arises from 4 bones:
    a. Its anterior wall and floor and the lower part of its posterior wall are formed by the tympanic bone

   b. The roof and upper part of the posterior wall are formed by the squamous bone
   c. Supero-posterior to the external opening is the suprameatal triangle with the spine of Henle
   d. Its inner end is closed by the tympanic membrane sitting in the bony annulus

External Ear Anatomy and Physiology

1. The external ear comprises the pinna and external auditory canal (EAC). Its function is to transmit sounds to the tympanic membrane.
2. The external 1/3 of the EAC is cartilaginous; the inner 2/3 is bony (see bony EAC above). The skin of the canal is thicker in the cartilaginous portion, includes a well-developed dermis and subcutaneous layer, and contains glands and hair follicles. The skin lining the osseous portion is thinner, firmly attached to the periosteum, and lacks a subcutaneous layer.
3. Cerumen is produced by the combination of secretions of two types of glands in the cartilaginous EAC and serves to clean, lubricate and has a slightly acidic pH that inhibits bacterial and fungal growth. Cerumen prevents epithelial maceration that can occur from residual moisture in the ear canal. The two glands and their products are:
   a. Sebaceous glands produce sebum
   b. Modified apocrine glands produce apocrine sweat
4. Sensory Innervation of the EAC:
   a. Greater auricular nerve and lesser occipital nerve (branches of the cervical plexus) innervate the skin of the auricle
   b. Auriculotemporal nerve (branch of the mandibular nerve) innervates the skin of the auricle and external auditory meatus.
   c. Branches of the facial and vagus nerves innervate the deeper aspect of the auricle and external auditory meatus
      i. *Practice Guideline 1: the branch of the vagus nerve in the ear canal is called Arnold's nerve, nicknamed Alderman's nerve. Aldermen (town councilmen) were known to scratch their ear canals with their pen's quills in order to stimulate this nerve and set of a coughing fit, enabling them to leave meetings early.*
      ii. *Practice Guideline 2: an early sign of vestibular schwannoma can be diminished sensation of the upper outer part of the EAC due to compression of the facial nerve in the internal auditory canal. This is called Hitselberger's sign but it is primarily of historical significance.*
5. Lymphatic Drainage is to the superficial parotid, mastoid, upper deep cervical and superficial cervical nodes

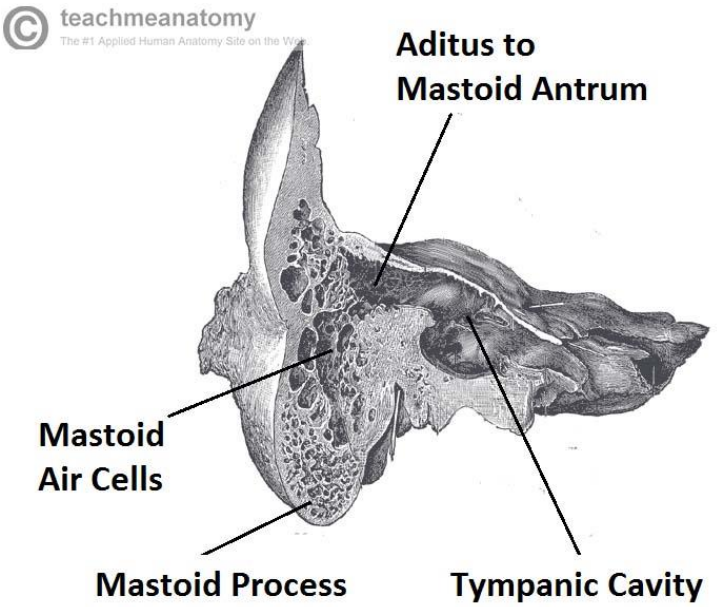


Figure 1. Osseous temporal bone anatomy, medial view.

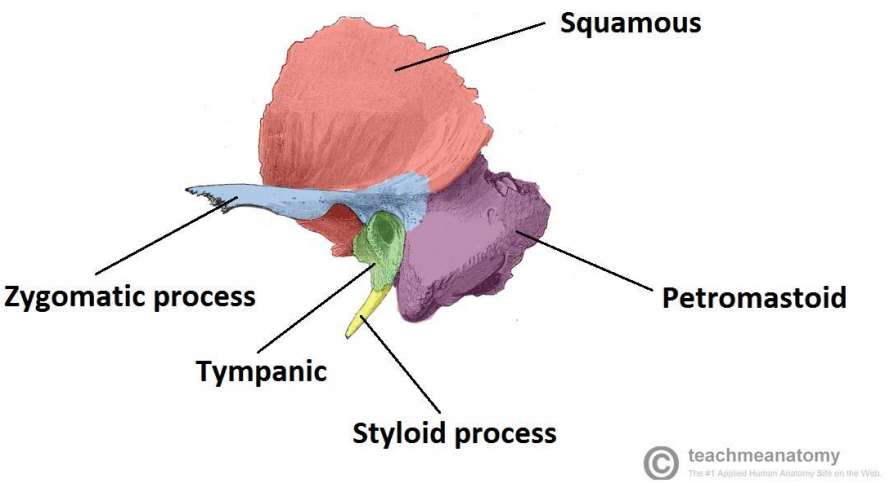


Figure 2. Osseous temporal bone anatomy, lateral view.

Middle Ear Anatomy and Physiology

Overview

The middle ear lies within the temporal bone and extends from the tympanic membrane to the lateral wall of the inner ear. The main function of the middle ear is to transmit vibrations from the tympanic membrane to the inner ear via the auditory ossicles. There are two shared

but relatively distinct spaces: the mesotympanum (middle ear) and the epitympanum (attic). Subsets of the mesotympanum include the hypotympanum inferiorly and protympanum anteriorly.

1. Walls of the middle ear:
   The middle ear can be visualized as a closed space, with a roof and floor, medial and lateral walls and anterior and posterior walls.
   a. *Roof* (tegmen tympani) is formed by a thin bone from the petrous part of the temporal bone. It separates the epitympanic part of the middle ear from the middle cranial fossa
      i. It is contiguous with the roof of the mastoid, also called tegmen mastoidii or tegmen antrii (for roof of antrum)
   b. *Floor* contains the hypotympanic air cells, beneath which lies a thin layer of bone over the internal jugular vein (or jugular bulb)
   c. *Lateral wall* is made up of the tympanic membrane - pars tensa is defined by the tympanic ring and, superiorly, pars flaccida is defined by the notch of Rivinus
   d. *Medial wall* is formed by the promontory, which is the lateral wall of the otic capsule (inner ear) and contains a prominent bulge of the horizontal facial nerve canal and, anteriorly towards the protympanum, the semicanal of the tensor tympani muscle
   e. *Anterior wall* is a thin bony plate with superior openings for the Eustachian tube, the tensor tympani muscle and the chorda tympani nerve (iter chordae anterior). It separates the middle ear from the internal carotid artery
   f. *Posterior wall* (mastoid wall) consists of a lower bony partition between the tympanic cavity and the mastoid air cells
      i. Superiorly, there is an opening in this partition, the aditus ad antrum, which allows for air flow between the middle ear and mastoid.
      ii. Inferiorly, there is a potential space, the facial recess, between the vertical lie of the facial nerve medially and the chorda tympani nerve in iter chordae posterior (before it enters the middle ear space).
         - *Practice Guideline: The facial recess is used surgically to enhance aeration pathways in canal wall up surgery, to define the level when taking the canal wall down in chronic ear disease, or to provide access for implantation of hearing devices such as cochlear implants and active middle ear implants.*
2. Mucosal lining of the middle ear:
   a. The middle ear is lined with squamous and ciliated columnar cells.
   b. The posterior mucosal lining is composed of non-secretory flat squamous epithelium. The number of ciliated columnar epithelial cells in the mucosal lining progressively increases toward the eustachian tube to constitute about 80% of the cells adjacent to the eustachian tube entrance.
   c. These histomorphological changes evidence the progressive transformation from flat, nonsecretory squamous epithelium to respiratory epithelium that is

pseudostratified, ciliated columnar cells just proximal to the eustachian tube entrance.

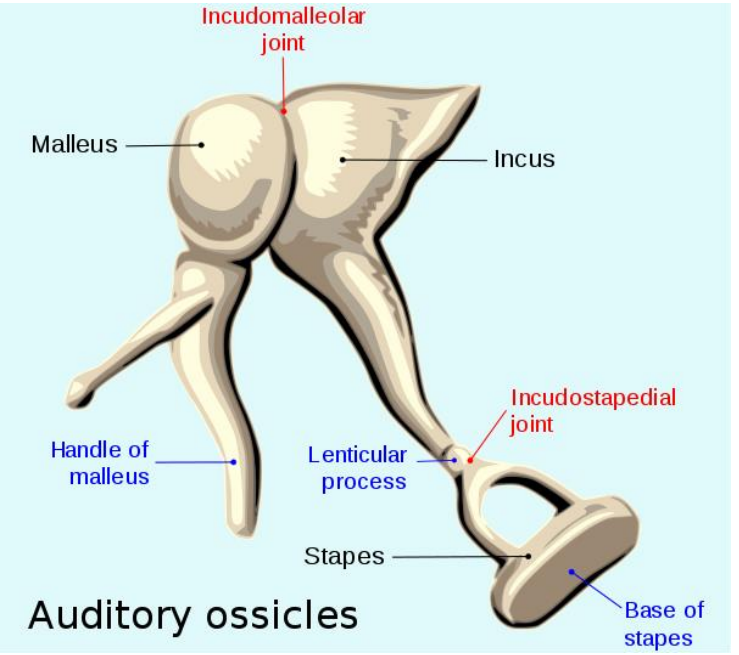
d. The changing cellular architecture of the middle ear cavity facilitates function of an organized mucociliary transportation system from primarily the epitympanum and hypotympanum to the eustachian tube.

Tympanic Membrane

1. The tympanic membrane (TM) is the medial wall of the EAC and lateral wall of the middle ear. The larger surface area is called the pars flaccida and the smaller, superior, portion is called the pars tensa. The membranous annulus of the TM sits within the bony annulus of the tympanic ring and holds the membrane in place to allow for its vibration in response to sound.
2. Sound vibrations in air are captured by the EAC and cause a movement in the TM which then creates oscillation of the ossicles. This movement helps to transmit the sound waves from the tympanic membrane to the oval window at the internal ear.
3. Its diameter is about 8–10 mm and its shape is that of a flattened cone with its apex directed inward. The ratio of the surface area of the TM to the oval window is 20:1, and that serves to allow adequate energy transfer between air and the inner ear fluids, preserving approximately 98% of the sound energy.
4. Structure of the TM is three-fold:
    a. The lateral or outer or epithelial layer arises from the first branchial arch embryologically
    b. The middle, fibrous layer, has two layers within it: one circular array and one radial array of fibers, giving the TM its strength.
        i. *Practice Guideline: Calcium depositions in the TM are in the fibrous layer, called myringosclerosis if only involving the TM and tympanosclerosis if also involving other middle ear structures, and are secondary to infection and inflammation.*
    c. The medial or inner or mucosal layer arises from the first branchial pouch embryologically.
5. *Practice Guideline: Congenital cholesteatoma is caused when, in the developing TM, the lateral (epithelial) layer gets pinched inside into the medial (mucosal) layer as the first branchial arch and pouch meet. That small 'knuckle' of epithelium is then trapped inside the middle ear and is often seen as a small white ball or pearl just anterior to the neck of the malleus. It may be missed and only identified after it has grown or disrupted its sac.*

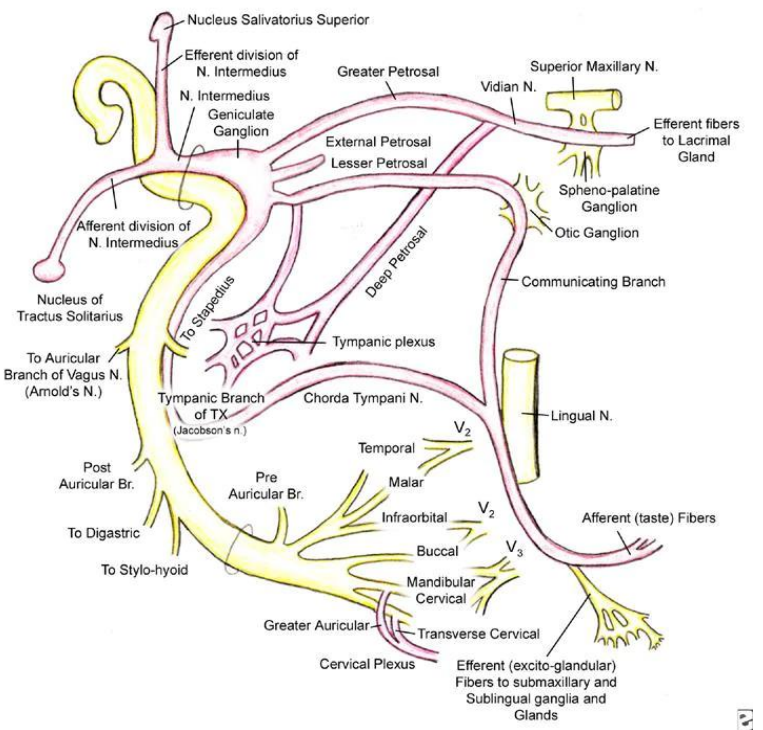
Ossicles

1. The bones of the human middle ear are the malleus (hammer), incus (anvil) and stapes (stirrup). They are connected via two joints:
    a. The incudomallear joint is a synovial joint in the epitympanum between the head of the malleus and the body of the incus.



From: https://simple.wikipedia.org/wiki/Ossicles.

Figure 3. Auditory ossicles.



From: https://emedicine.medscape.com/article/1290547-overview#a2.

Figure 4. Intratemporal course and branches of the facial nerve.

jugular vein. Inferior thyroid vein travels without arterial complement, extending from the inferior pole to the internal jugular or brachiocephalic vein.

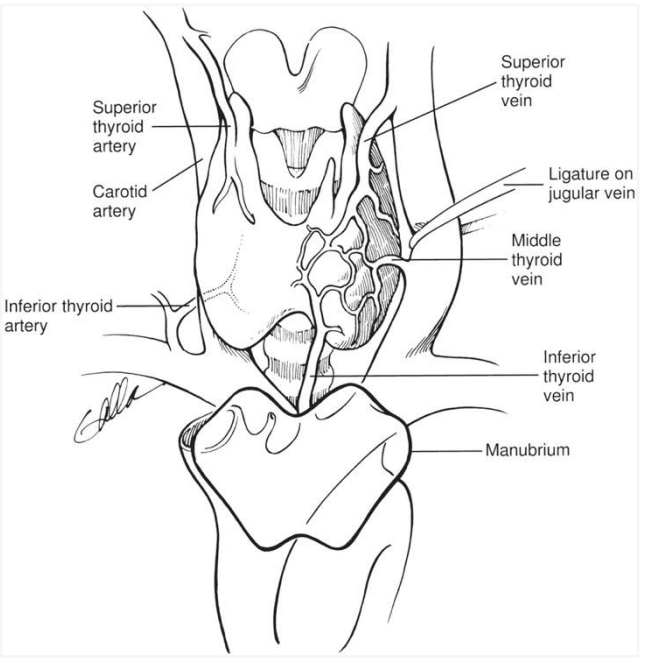


Figure 1. Posterior view of thyroid showing superior and inferior thyroid arteries and their relationship to the RLNs.

6. Recurrent and Superior Laryngeal Nerves
    a. The cervical branches of vagus nerve that are of concern during thyroid surgery include both internal and external branches of the superior laryngeal nerve (SLN) as well as the RLN (Figure 2).
    b. SLN
        i. SLN's internal branch supplies sensation (general visceral afferents) to lower pharynx, supraglottic larynx, and base of tongue, and special visceral afferents to epiglottic taste buds.
        ii. SLN's external branch provides motor innervation (branchial efferents) to inferior constrictor and cricothyroid muscle. Contraction of cricothyroid is important for increasing vocal fold length and tension, which is important for production of high-frequency phonation.
        iii. SLN arises from upper vagus nerve and descends medial to carotid sheath dividing into internal and external branches ~ 2 to 3 cm above superior pole.
        iv. Internal branch travels medially to carotid system, entering posterior aspect of thyrohyoid membrane, providing sensation to ipsilateral supraglottis.

mediastinum. Lastly, US is a non-physiologic study—i.e., not specific for abnormal parathyroid glands vs small lymph nodes or other lesions

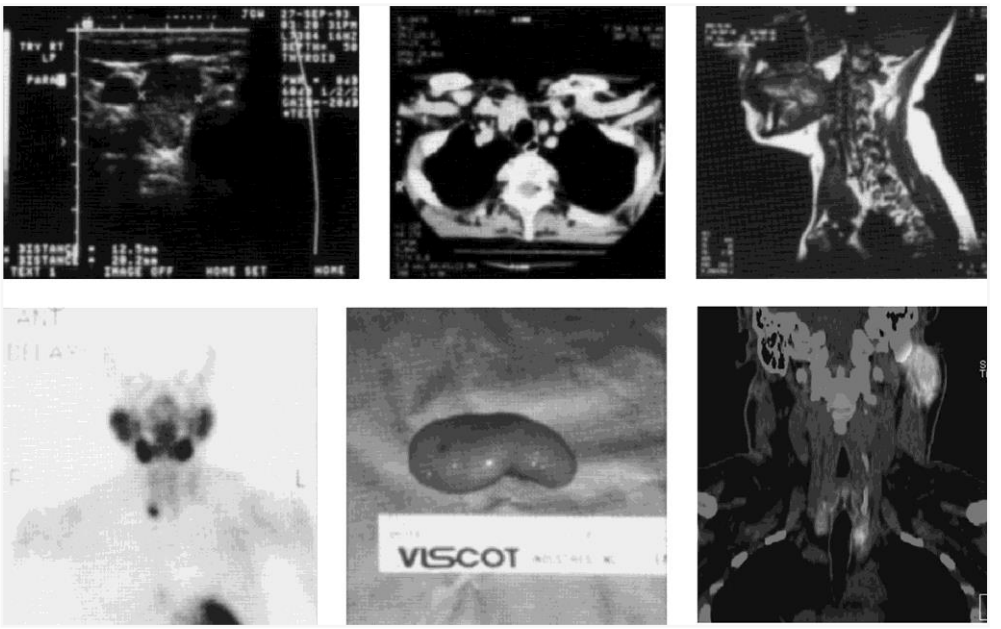


Figure 6. Parathyroid localization tests: parathyroid adenoma seen on Ultrasonogram, CT, MRI, (top), and planar sestamibi scanning, gross pathology, and SPECT/CT of parathyroid adenoma (bottom).

3. Sestamibi (Technetium 99m, Tc99MIBI) Scan
    a. Sestamibi is initially taken up by both thyroid and parathyroids. Tracer uptake in the thyroid washes out more quickly than adenomatous parathyroid glands. Two-hour interval scans show tracer retained within adenomatous parathyroid glands. The uptake and retention of sestamibi is related to cellular mitochondrial content. Single photon emission computerized tomography (SPECT) scanning increases the accuracy of sestamibi scanning by combining scintigraphy with CT imaging for improved 3D localization.
    b. Advantages: Useful for detecting single adenomas with a sensitivity of 89%. May detect ectopic adenomas.
    c. Disadvantages: Low sensitivity for multi-gland disease, hyperplasia, and small adenomas.
4. Four-Dimensional CT (4D-CT)
    a. Contrasted CT protocol that assesses contrast uptake at multiple points in time to allow for differentiation of tissues by contrast retention over time. The scan typically includes a non-contrast phase, an arterial phase (25-30s after contrast injection), and a delayed phase (60-80s after contrast injection).
    b. Advantages: Provides both anatomic and physiologic information. High sensitivity (≥85%) in localizing parathyroid adenomas to a single side. Excellent in identifying ectopic glands.

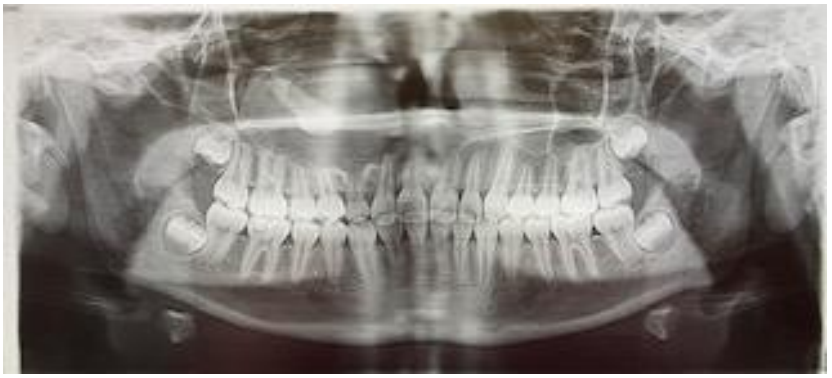


Figure 3B. Orthopantomogram of Adenomatoid odontogenic tumor of the Maxilla. Orthopantomogram demonstrates well circumscribed lesion of the right maxilla encompassing a displacing a right maxillary canine.

   b. Histopathology may have duct like structures owing to the adenomatoid name, however these are not true ducts or glandular structures. [201]
4. Management:
   a. Encapsulated lesion, so enucleation is treatment of choice and often if tooth is involved can be spared. [200]
5. Prognosis:
   a. Unlikely to recur. [200]

Squamous Odontogenic Tumor (SOT)

1. Definition: Locally infiltrative neoplasm well differentiated squamous epithelium in fibrous stroma. [202]
2. Description/Clinical features:
   a. Can exist intraosseous or peripheral. [202]
   b. Extremely rare. [203]
   c. Painless +/- painful gingival swelling associated cortical expansion with tooth mobility. [203]
   d. Mandible affected more than maxilla. [203]
3. Diagnosis/Imaging:
   a. Nonspecific. Radiolucent defect that can be triangular in shape between roots of teeth. [203]
   b. Histopathology varying islands of bland squamous epithelium in mature fibrous connective tissue. [203, 204]
4. Management:
   a. Local excision or curettage. [204]
   b. Maxillary squamous odontogenic tumors more likely to invade adjacent structures (due to the porous nature of maxillary bone compared to mandible). [204]
5. Prognosis:
   a. Typically do not recur after conservative surgical treatment and extraction of teeth. [204]

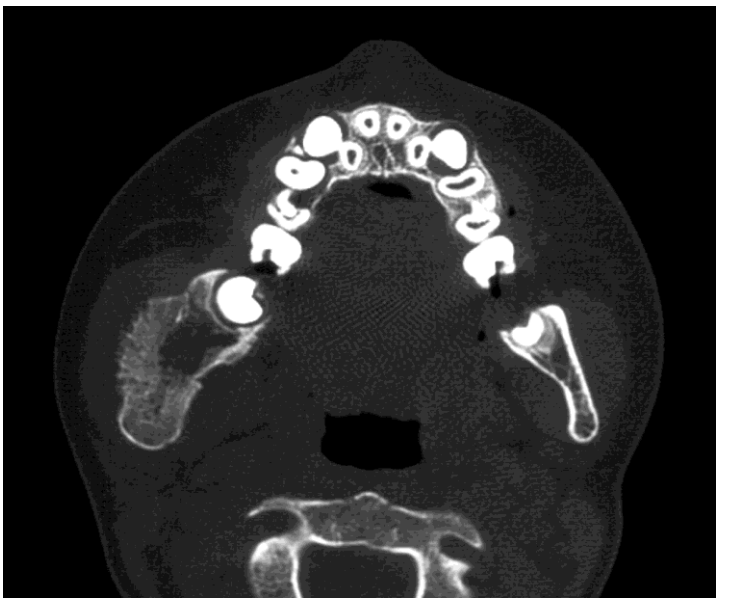


Figure 4A. CT of Osteosarcoma of the Mandible.
Axial CT showing a heterogeneously enhancing mass originating from right mandibular ramus. Extensive cortical erosion is noted, and the involved bone shows abnormal spiculated periosteal elevation which is radiating outwards. Another imaging differential includes mandibular chondrosarcoma.

Figure 4B. 3-Dimensional Reconstruction.
Seen in this image is the 3-dimensional reconstruction of the prior scan, with the osteosarcoma mass visible on the ramus of the right mandible.

2. Description/Clinical Features:
    a. Aggressive tumor characterized by a poor prognosis
3. Diagnosis/Imaging:
    a. CT, PET.
    b. IHC: Vimentin CD31, CD34, and factor VIII-related antigen. [230, 231]

ii. *Nonhomogeneous*: Predominantly white or red and white lesion that may be speckled, nodular, exophytic, or verrucous. It is associated with a higher risk of transformation to malignancy:
- Risk of transformation in oral cavity: 20-25%.
- Proliferative verrucous leukoplakia is sometimes categorized as a third entity outside of leukoplakia and erythroplakia.
- *Nodular*: slightly raised, rounded, red and or white excrescences
- *Exophytic*: irregular sharp or blunt projections
- *Proliferative verrucous*: (see below)

iii. Size: larger than 200 mm^2 has been found to be associated with a risk of malignant transformation

iv. Dysplasia (see below)

2. *Oral leukoplakia*: Leukoplakia of the oral cavity (see Figure 1.)
   a. More common in older males and tobacco and alcohol users.
   b. risk of dysplasia of 15.6-39.2% in oral leukoplakic lesions.
   c. Overall risk of transformation 0-25%.

Figure 1. Nonhomogeneous leukoplakia of the buccal mucosa.

3. *Oropharyngeal leukoplakia*: This entity is less-commonly described than oral or laryngeal leukoplakia. It can theoretically occur in any oropharynx subsite and may precede development of oropharyngeal SCC.
4. *Laryngeal leukoplakia*: This lesion is located most commonly on the true vocal folds at the medial and superior edges and anterior commissure.

   a. Annual incidence is estimated at 4.2:100,000 in the United States and is more common in men.
   b. Tobacco smoking is the main risk factor.
   c. Overall risk of malignant transformation is 14.1%. More specifically, the risk of transformation is 3.7% in laryngeal leukoplakia without dysplasia on initial biopsy, 10.1% with mild to moderate dysplasia, and 18.1% with severe dysplasia.

5. *Erythroplakia*: Red lesion that may be flat or depressed, atrophic, and nonkeratinized. The red coloration comes from underlying vascularity.
   a. Oral and oropharyngeal erythroplakia occur most commonly on the soft palate, floor of mouth, ventral tongue, and tonsillar fossae.
   b. Risk factors include tobacco and alcohol usage.
   c. It is less common than leukoplakia (prevalence rate reported 0.02-0.2%)
   d. Significant risk of underlying dysplasia (90%) and a high risk of malignant transformation.
   e. Risk of transformation is estimated to be 7 times higher than oral leukoplakia with an overall rate of 14-50%.
      i. In the larynx, erythroplakia has a 4 fold risk of malignancy compared to leukoplakia.
6. *Proliferative Verrucous Leukoplakia (PVL)*: Oral PVL lesions initially appear as solitary, flat, homogeneous white patches. They progress to thickened multifocal lesions, with exophytic papillary and later verrucous stages. (See Figure 2.)
   a. PVL is more common in women and nonsmokers.
   b. It has a very high risk of transformation to malignancy (43.87-63.9%) and high risk of recurrence (71.2%).

Figure 2. Proliferative verrucous leukoplakia of the mandibular gingiva. Periprobe for lesion measurement.

7. *Submucous fibrosis*: Fibrotic process that begins in the lamina propria of the oral cavity and presents with stiffening and blanching of the oral mucosa.
   a. Overactive fibroblasts lead to increased deposition of extracellular matrix,

Table 1. Work up of suspicious neck mass

cN+, known primary	Physical exam, flexible fiberoptic laryngoscopy, DL + biopsy, FNA, p16 testing if oropharynx, CT + PET if advanced stage
cN+, occult primary	Physical exam, flexible fiberoptic laryngoscopy, FNA, p16, EBV, CT + PET, DLB, consider TORS BOT mucosectomy/tonsillectomy
cN0 neck, known primary	
Salvage after definitive CRT	Post-treatment PET after 3 months

Primary Sites

Mucosal cancers of the head and neck are divided into oral cavity (mucosal lip/vestibule, alveolar ridge, floor of mouth, oral tongue, buccal mucosa, hard palate, retromolar trigone), oropharynx (palatine tonsil, lingual tonsil, soft palate), larynx (supraglottis, glottis, subglottis), hypopharynx (piriform sinus, postcricoid/esophageal inlet, posterior pharyngeal wall), nasopharynx, and nasal cavity.

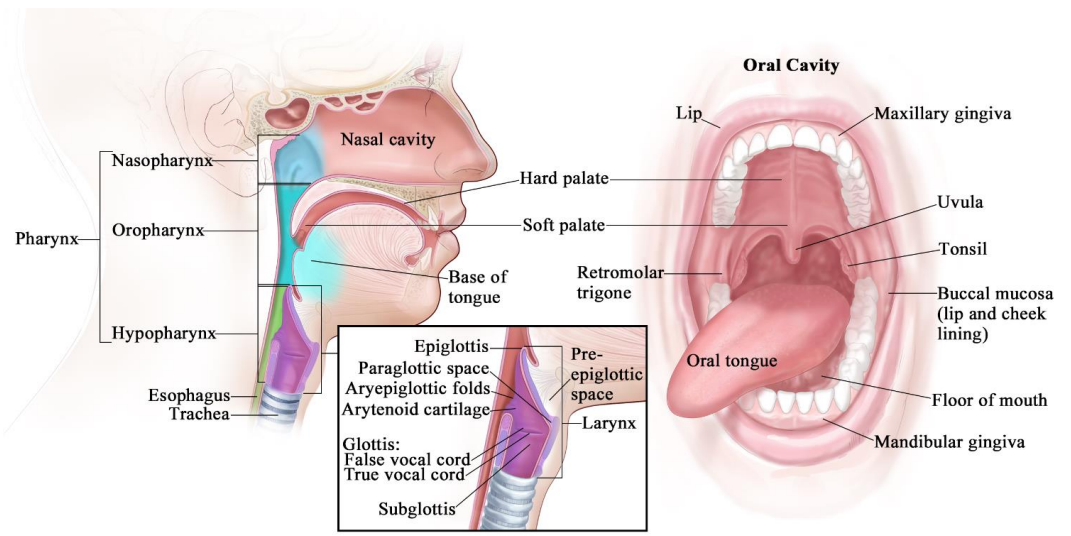


Figure 2. Mucosal sites and subsites of the head and neck (Illustration ©2022 Terese Winslow LLC).

Lymphatic Drainage and Likely Involvement of Neck Levels

1. Nasopharynx [3]
    a. Nasopharynx – II, V, retropharyngeal, often bilateral.
2. Oral cavity [4]
    a. Upper lip – IB, perifacial, periparotid, level II.
    b. Lower lip – IA, IB bilaterally, perifacial, level II.
    c. Upper alveolar ridge – IB, II, bilateral if midline.

2. Informed consent should include bleeding, infection, pain, scar/cosmetic deformity, lower lip/arm/tongue/shoulder weakness or paralysis, failure of procedure, recurrence or persistence of disease, need for additional procedures.

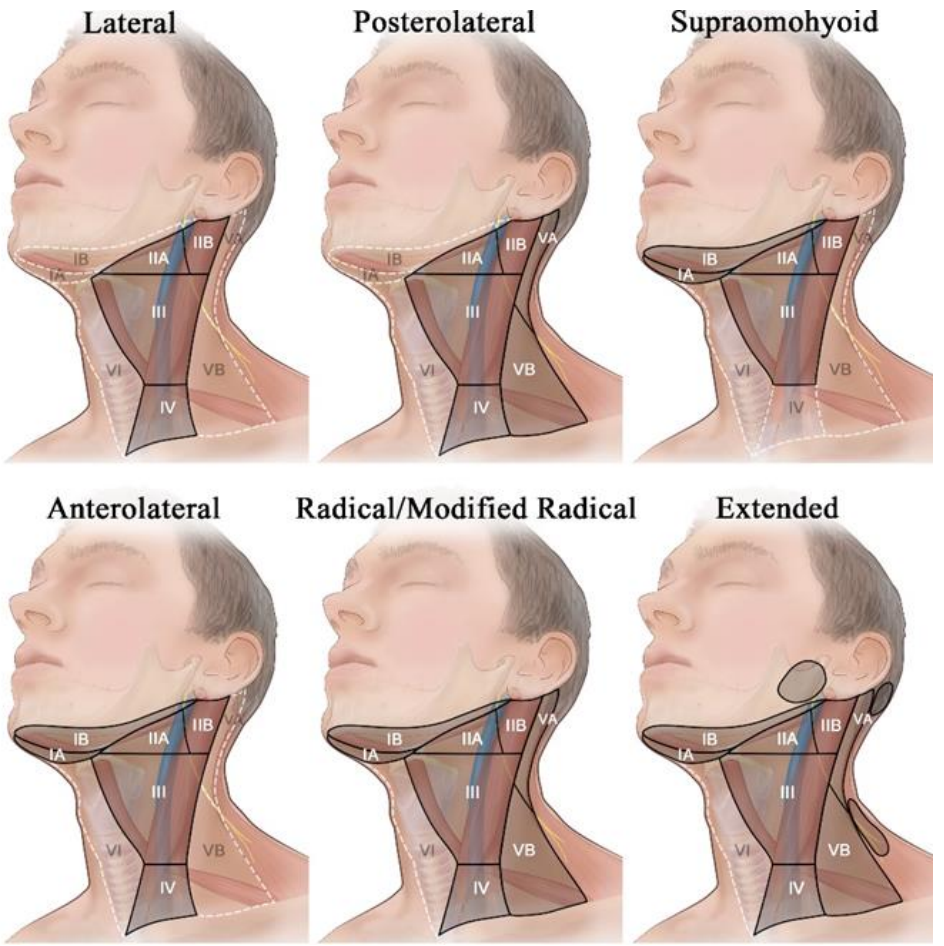


Figure 3. Extent of neck dissection types (Illustration © 2022 Terese Winslow LLC).

Set Up

1. General anesthesia without long-acting paralysis to allow for nerve monitoring of marginal mandibular, CN XI, CN XII.
2. Clean case, only perioperative antibiotics indicated. If communication between the upper aerodigestive tract and neck during ablation of tumor, consider treating as a clean/contaminated wound.
3. Supine, neck extended with shoulder roll and turned contralaterally
4. Prep and drape to include lower lip, clavicle, trapezius, earlobe, midline neck.

Answers to Multiple Choice Questions

Chapter 2:

1. c
2. b
3. c
4. e

Chapter 3:

1. c
2. d
3. b
4. c
5. b

Chapter 4:

1. a
2. c
3. b
4. a
5. b

Chapter 8:

1. d. The successful treatment of thrush has revealed a potentially malignant laryngeal lesion. The surgeon should evaluate with direct laryngoscopy and microflap biopsy to rule out dysplasia or malignancy.
2. c. All of these lesions have high rates of transformation, but PVL has the highest.
3. d. PVL has not been associated with standard risk factors for oral premalignancy. It is more commonly described in women.
4. d. This adolescent has leukoplakia and other physical characteristics of Fanconi Anemia. In addition to risk of head and neck squamous cell carcinoma, patients with FA are at significant risk of bone marrow failure. The patient should be seen by other services like hematology and medical genetics after a close head and neck evaluation. 5. e. Thus far, no chemoprevention agents have proven to durably decrease the risk of transformation to malignancy. Currently, risk factor reduction and close follow-up remain the standard of care. Interestingly, there is no prospective trial to show a decreased rate of malignancy after surgical excision or ablation of leukoplakia.